Space Weather Technical Forecast

Issued on Wednesday, 09 August 2023 at 13:03 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Minor ongoing solar radiation storm, S1 waning. Slight chance of M-class flares (R1-R2; Minor-Moderate radio blackouts) throughout.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity is Low, peaking at 08/1810 UTC following a C-class flare that originated from AR3394 in the southwest quadrant of the visible solar disc. Seven sunspot regions are in evidence on the Earth-facing solar disc, with the majority of the regions stable and unipolar, else bipolar and in decay, with little overall change observed in the past 24 hours. AR3387 has now rotated across the northwestern limb, and had a Dsi/Beta-Gamma configuration, it follows close behind ex-3386, with some magnetic connection appearing over the limb. Both AR3395 in the northeast and aforementioned AR3394, in the southwest, have both shown some minor changes in periphery spots and pores surrounding the penumbral central spots. No Earth-directed CMEs have been observed in available coronagraph imagery in the period.

Solar Wind / Geomagnetic Activity: The solar wind, as measured at L1 by ACE and DSCOVR spacecraft observatories, was indicative of a weakening solar wind, which started at mostly slightly elevated levels with a peak of 514 km/s at 08/1801 UTC, before drifting towards Slow levels at around 400 km/s .The solar density has been mostly average throughout, but drifted close to slightly above by the end of the period, peaking at 14 pfu at 09/1120 UTC. The IMF has been weak, peaking at +6nT, with the all important north-south component (Bz) varying between +6 and -5nT. The phi angle varied between negative (towards the Sun) to positive (away from the Sun). The net effect of the above solar wind parameters was for Quiet geomagnetic conditions (Kp1-2).

Energetic Particles / Solar Radiation: GOES16 high energy (greater than 10 MeV) proton flux showed a response to the X1.5 flare peaking at 07/2046UTC from Ex-AR3386 (which as now rotated beyond the NW limb) with observed levels remaining above the S1 Minor Solar Radiation storm threshold and reaching 48 pfu at 08/0025. High energy (greater than 2MeV) electron flux was initially at background levels, rising to Moderate levels, with a peak of 721 pfu at 08/1720 UTC, during its diurnal cycle. The associated 24-hour integrated fluence remained well below the Active level (1e8 integrated pfu), with 2.21e7 integrated pfu recorded at 09/0001UTC with a level trend currently.

Four-Day Space Weather Forecast Summary

Solar Activity: Low levels od solar activity are anticipated, with only a slight chance of further M-class flares. The greatest risk for this occurring is probably from AR3395 in the northeast quadrant and currently approaching centre-disc, with any further daily additional contribution from regions arriving from around the eastern limb.

Solar Wind / Geomagnetic Activity: No coronal hole high speed streams (HSS) winds feature

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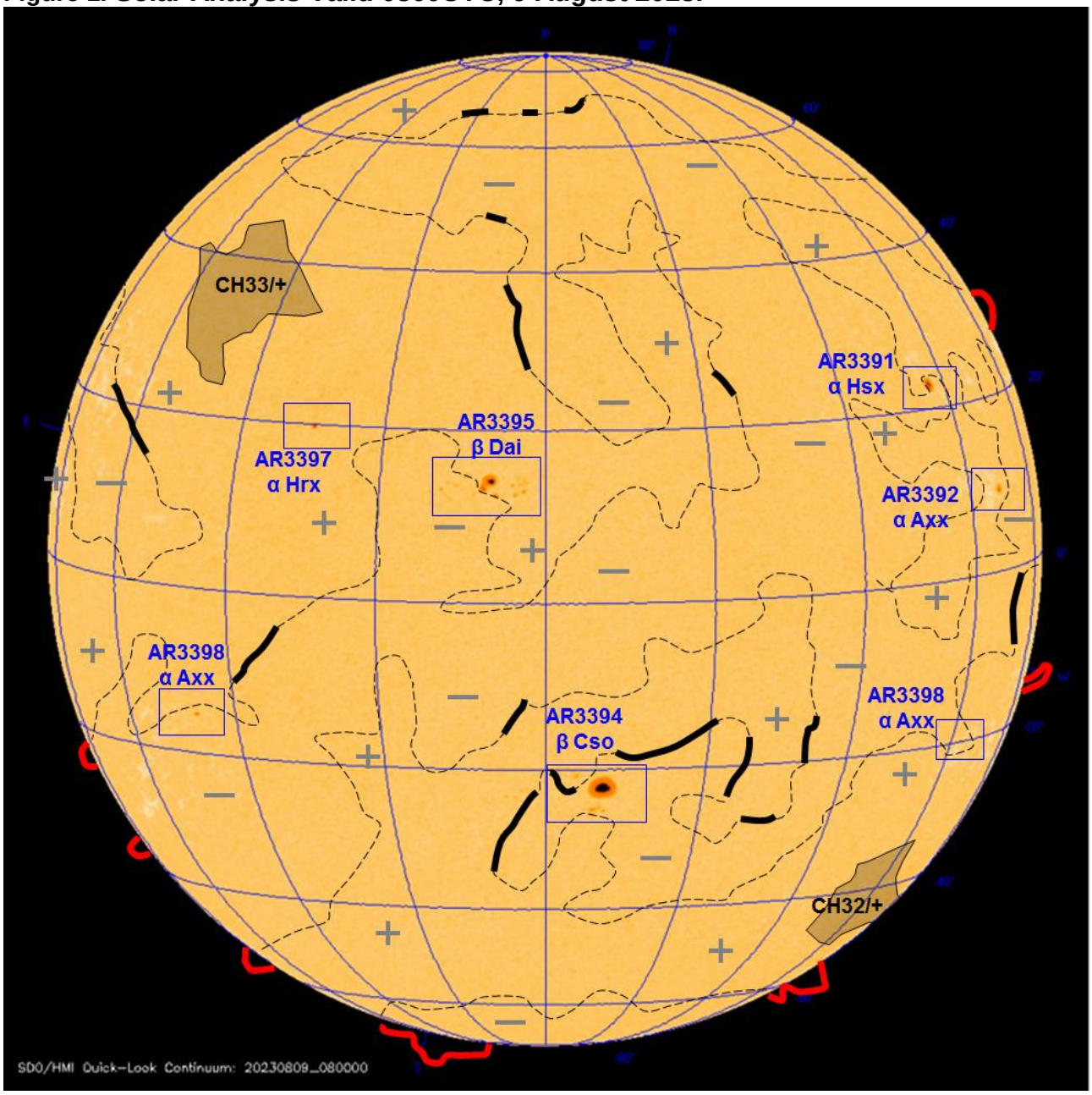
in the forecast, and there have been no new modelled Earth-directed CMEs in the past 24 hours. Geomagnetic activity mostly Quiet (Kp 0-2) throughout the period, with a chance for Unsettled to Active)Kp 3-4) intervals probably during the remainder of Day1 (9 Aug).

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux should show a decreasing risk of further breaches of S1 as the primarily responsible region rotates further around the far side, falling from Expected to a near background. Slight Chance by the second half of the current UTC working week. The high energy (greater than 2 MeV) electron flux carry a daily Chance of reaching High levels. The associated fluence is expected to remain below Active, with a probable flat or weakly rising trend.

Figure 1. Solar Analysis Valid 0800UTC, 9 August 2023.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

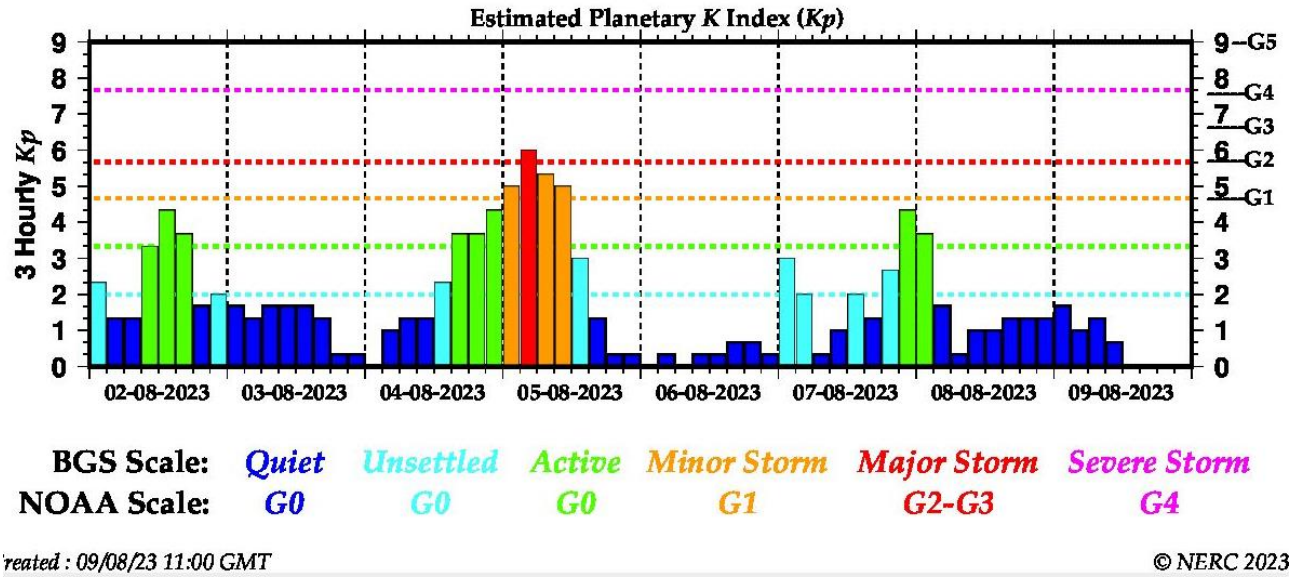
No significant coronal hole fast winds (HSS) are likely for the coming four days, with no further Earth-directed CMEs currently in the forecast. The two glancing blow CMEs that were due to affect Earth late on the 08 Aug do not appear to have given significant impacts from evidence visible at STEREO-A on MAG and PLASTIC instruments despite being at 0.95AU. Therefore, these are now considered to have missed Earth with no further impacts likely. As a result, geomagnetic activity is most likely to be Quiet throughout, with the slight chance of isolated Unsettled or Active intervals in the first 6 -12hours as solar winds remain close to slow-ambient or slightly elevated levels of 400 km/s.

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	1	1	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil.

Figure 2: BGS Estimated Planetary K Index (Kp), with Quiet levels currently observed.



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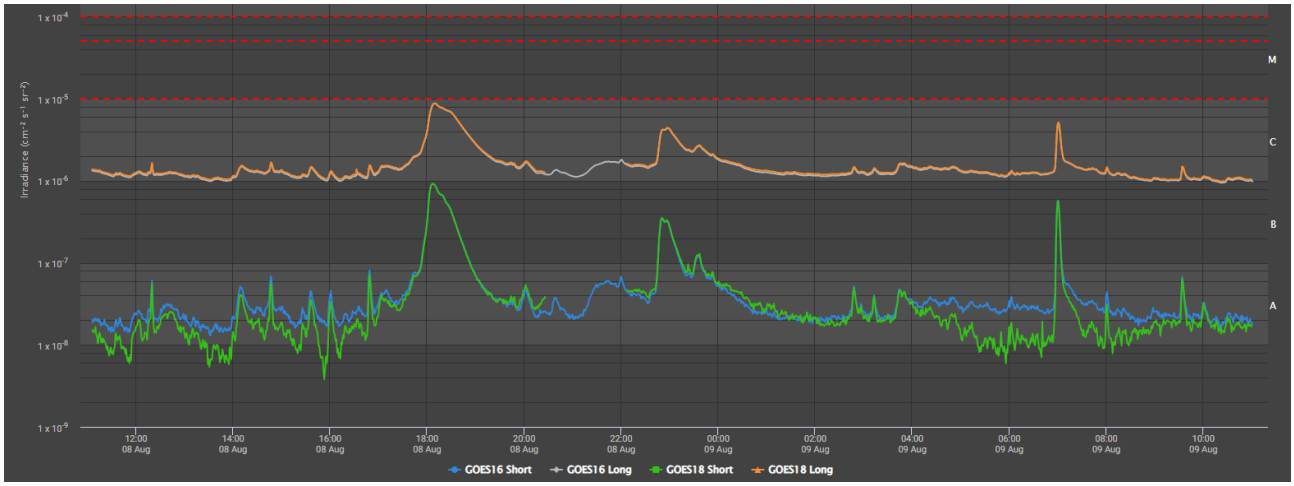
Radio Blackouts - X-Ray Flares:
Seven sunspot regions cover the visible solar disc. Most of the groups on the disc are either unipolar or else simple dipoles with stable or fading tendencies. AR3394 and AR3395 both show some minor development in the periphery spots and pores. Solar activity is Low and AR3395 is probably now the main risk for any isolated M-class flares. This risk receding towards raw values in the coming days. Any additional risk contribution from the eastern limb remains to be seen and some brightening in magnetic flux is quite evident on the northeast limb with an active region probably appearing in the coming 24 to 48 hours.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	30	20	20	30
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: GOES16-18 X-Ray Flares at GEO with C-class flare activity observed in past 24 hours.



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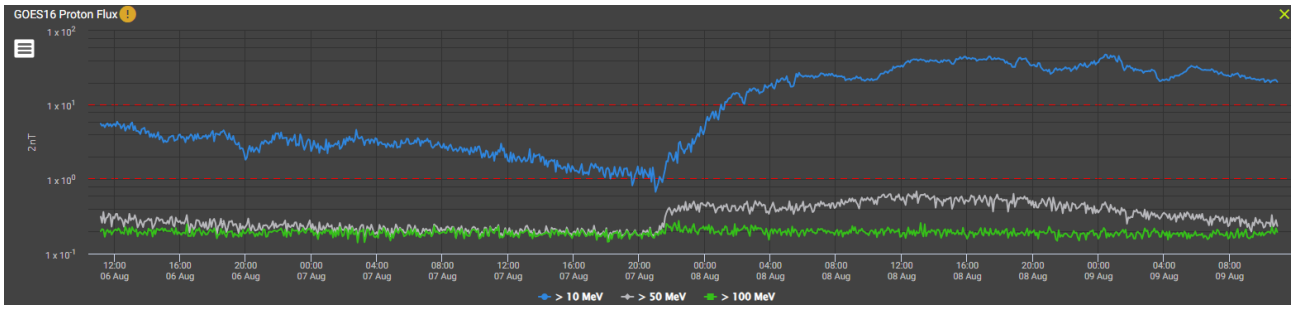
Solar Radiation Storms - (High Energy Protons):
Further flares from Ex-AR3386 and possibly AR3387 could keep solar radiation levels above the S1, minor storm threshold during the coming day before the active regions rotate away sufficiently far round the far-side to limit the risk of further notable proton enhancements. It is also worth noting that while there is no history to speak of, AR3387 may also serve to enhance levels should it continue its habit of producing M-class flare activity as it approaches the limb. Solar radiation storms at the S1 level are likely to remain ongoing for the coming six to twelve hours but the risk should lower to a Slight Chance by Day 3 (11 Aug) as the regions responsible rotate further from view.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	Yes	100	50	10	5
Very Active	**≥ S3 ***	No	5	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: GOES-16 Proton flux – past 3 days shows the current S1 radiation storm on-going, after recent notable flare events.



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High Energy Electrons Event (≥ 2MeV):
The high energy electron flux (greater than 10 MeV) observed by GOES16 has shown a slight recovery over the past 48 hours, however with no further significant HSS expected, only a modest flux rise during the diurnal cycle is expected, and probably reaching close to the daily high flux threshold. Overall, the associated 24-hour integrated fluence is likely to stay below the Active level, with a most likely flat or slightly rising trend. The Met Office REFM guidance is considered to be providing useful guidance with little overall change likely, although the fall indicated on Day 3 (11 Aug) is probably not likely.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	20	30	30	30
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 5: MOSWOC REFM – electron fluence guidance and high energy electron flux over past 3 days.

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